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Agricultural Research

Good Foods Made Better

Breeding and Good Taste

You're out for a pastoral stroll on a lovely crisp autumn day, scuffing the leaves in front of you as you pass by a weathered, abandoned farmhouse. At one corner of the sagging house, an ancient-looking tree is dotted with small but inviting blush-red apples. You snag one, give it a five-second polish on the front of your shirt, and sink your teeth into the purloined fruit.

You've just rolled Mother Nature's dice. Maybe that apple you chose is a delectable treat—or maybe the first bite will leave you chucking the rest of the apple back at the tree.

We tend to think of fruit as just "naturally" delicious, practically failsafe, a sweet little bonus from nature. In fact, producing a consistently tasty fruit is a time-consuming, intricate business.

For example, if you plant 1,000 apple seeds, you're lucky if 1 percent of the resulting trees have flavorful fruit, reasonable yields, and the ability to withstand adverse weather conditions such as cold, heat, and drought. In one pear-breeding program in which I once worked, I calculated that we had to plant and evaluate 60,000 seedlings to produce a single new variety with the attributes we wanted.

But you can find out in a single growing season whether a new vegetable variety is a success. Because of this quick response, vegetable breeders have had many plant generations in which to find the carrot or onion with just the right mix of genes.

Fruit is another story. If you plant an apple or orange seed, 8 to 12 years may pass before you can harvest any fruit from the trees. So breeders have had fewer generations of fruit in which to pick and choose the varieties with the precise combination of genes they want.

Fruit trees are not only slow, they're tricky. That's because the genetic material of fruits is highly variable; when you plant seed, it's not often that you get something as good as the parents. Also, pollen carried by bees and wind carries its own genetic message from a completely unknown parent tree.

Now for the good news: Plant breeders are a persistent bunch. We in ARS have a genuine concern for developing new fruit and vegetable varieties that meet and hopefully surpass current standards of public acceptability.

Does this include concern about flavor? Absolutely.

Flavor is especially important in fruit crops because most people eat fruit primarily for its flavor—not because it's "good for them."

That's why we're so excited when we have a success like Flame Seedless grapes, introduced by our Fresno, California, lab in late 1973 and now grown worldwide. Not only do these grapes really live up to the name "seedless," they also have a very distinctive flavor. They've been such a hit that today, whenever you buy red seedless grapes, it's likely that they are Flame Seedless.

Projects like USDA's Plant Genome Mapping program will help us develop the tastiest fruits and vegetables by giving us detailed information about these plants' genetic makeups. The genome mapping includes work on staple crops like wheat and corn, but also encompasses projects on asparagus, carrots, citrus, cucumbers, lettuce, onions, and strawberries, to name a few examples.

In the early 1800's, an itinerant missionary commonly known as Johnny Appleseed roamed Ohio and Indiana, preaching and planting apple seeds he'd taken from the pomace left over from apple cider mills. He thought apples were good fruit and he wanted to ensure Americans would have plenty of them.

Today we in ARS have a similar idea about all sorts of fruits and vegetables. But we're as concerned with quality as quantity—probably more so. Our breeding programs are geared to making sure that next time you bite into an apple or nectarine or a tomato—unlike that apple on our imaginary walk—you enjoy what you've picked, down to the very last bite.

Howard J. Brooks
Associate Deputy Administrator
for Plant Sciences

Agricultural Research

Cover: Bringing the best to the American dinner table—that's the broad objective of USDA's crop improvement programs. The Agricultural Research Service, with university, state, and industry cooperators, has some impressive successes, as this month's stories attest. Photo by Keith Weller. (K3839-21)

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More Luscious Fruits

From Flame Seedless to Redglobe, ARS names dominate marketplaces.

You could make a delicious, colorful salad from all of the fresh fruits that ARS research in Fresno, California, has yielded. This bounty includes America's favorite red seedless grape and top-ranked apricot.

Scientists breed these popular fruits—plus an array of juicy plums, nectarines, and peaches—primarily for California orchards and vineyards. Growers in that state lead the nation in grape and stonefruit production. Harvests of the leading grape and stonefruit varieties from ARS breeders at the Horticultural Crops Research Laboratory in Fresno brought California growers about $159 million in 1993.

Of the more than 50 different kinds of summer fruits proffered by the laboratory during the past four decades, Flame Seedless red grape is perhaps the best-known. Crisp, attractively colored, and harvested only when perfectly sweet, Flame is second only to Thompson Seedless in popularity.

The first apricots you can buy each spring are likely Castlebrite, the country's No. 1 apricot for fresh-market sales. (Other apricot types are sold as dried fruit.) Castlebrite's large, firm fruit make a convenient and healthful snack.

Now, an appetizing new apricot called Helena awaits fresh fruit aficionados. Since 1975, more than 2 dozen venturesome growers throughout California's Central Valley have worked with the Fresno lab to plant and monitor the experimental apricot.

Helena is "larger and more flavorful than Patterson, a major variety that's sold at the same time of year, says Fresno geneticist Craig A. Ledbetter. "The skin and flesh of our new apricot are a much deeper orange than Patterson," he adds.

Ledbetter aims to have an initial supply of Helena budwood available to other growers—and backyard gardeners—by early 1995.

The Fresno laboratory's Friar and Blackamber black-skinned plums today make up 22 percent of California's commercial fresh plum harvest, notes ARS horticulturist David W. Ramming at Fresno.

PATRICK TREGENZA

Flame Seedless grapes. (K5632-3)

First in harvest volume, the plump, juicy, mild-flavored Friar plums "reminded me of a stout, black-robed friar," recalls breeder John W. Weinberger, now retired. He developed and named the plum in 1968. Blackamber—among the first black plums to ripen each spring—now places fourth in volume.

Fantasia nectarine, offered to growers three decades ago, was "larger, better looking, and more attractively shaped than many other nectarine varieties that ripened at about the same time," says Weinberger. The fruit has smooth-textured flesh that's delightfully firm. Outside, the highly colored skin is an appealing bright red on one-third to two-thirds of the surface, with an undercolor of bright yellow. Fantasia today places fifth in California's nectarine harvest.

Flavorcrest peach, now 20 years old, is a large fruit that's "great eating," according to Weinberger. He points out that the pleasing red color on Flavorcrest's skin won't darken the way that reds on some other peaches do. Flavorcrest is the third most widely planted fresh-market peach in California.

Other delicious new fruits from the Fresno researchers may show up in the produce section of your supermarket within the next 3 to 5 years. The laboratory's newest grape, Black Emerald, is a seedless beauty that's ready for harvest when no other top-quality, American-grown, black seedless grape is at the market.

Horticulturist Ramming is readying a new, early summer peach for 1995 release to growers. Interestingly, Ramming is promoting this new, as-yet-unnamed clingstone as a fresh-market fruit—the kind you eat out-of-hand. Typically, clings are grown for canning; freestone types are harvested for fresh market.

The new cling, however, is "sweeter and firmer than most other peaches you can buy in early May," says Ramming. Like other clings, flesh of the new peach remains firm, even as the fruit ripens. "You can leave it on the tree until it's full and sweet," says Ramming.

Working with a handful of orchardists, Ramming has tested the peach for more than a decade. Though the idea of breeding a cling peach to be eaten fresh, instead of canned, isn't new, it hasn't been extensively tried yet in California.

PATRICK TREGENZA

Can any plum match the splendid, candy-apple red of Fortune? For this July-ripening dazzler, credit two ARS plant breeders at Fresno, California—John W. Weinberger, now retired, and David W. Ramming of the Horticultural Crops Research Laboratory, who gave Fortune to growers in 1988. Trees consistently bear generous harvests of full-sized fruit. (K5632-4)

Ramming isn't worried. "This new peach tastes great," he says. "We think it's a winner."

The peach is the product of embryo culture, a laboratory technique that requires the careful removal of a pearl-white embryo from the immature seed of a developing peach. The embryo is the offspring of parent trees that were specially selected because they produce peaches that ripen in early spring. When carefully nurtured in laboratory petri dishes, each rescued embryo may form a plantlet. The plantlets are tended in the greenhouse until they can be planted outdoors in the research orchard.

Embryo culture, says Ramming, is sometimes called embryo rescue because researchers recover tiny embryos that likely wouldn't survive in nature.

SCOTT BAUER

Castlebrite is the nations's No. 1 apricot in fresh-market sales. (K5613-15)

Peaches Are Taking to the Hills

The hills of Appalachia seem an unlikely place to grow peaches.

We expect them to come from places like warm, sunny Georgia or California. But ARS scientists are breeding new varieties of fresh-market peaches that grow well in the Appalachian Mountains, as far north as central Pennsylvania.

"Sentry and Bounty are two peaches that grow well in Appalachia," Ralph Scorza reports. "Both ship well and are good for roadside stands. With firm flesh and good flavor, Bounty would make a fine home-canning peach."

A horticulturist, Scorza developed these two new peaches—originally selected by H.W. Fogle—at the ARS Appalachian Fruit Research Station in Kearneysville, West Virginia.

"Sentry peach trees are popular with our local growers," says Phil Baugher. He is sales manager for Adams County Nursery in Aspers, Pennsylvania, which carries over 50 peach varieties, including Sentry.

"We've seen a rise in demand for this peach over the past 3 years—primarily because the fruit is firm, large (about 3 inches in diameter), and has a good flavor. The trees resist bacterial spot, which some peach varieties are susceptible to."

Also, Baugher notes, Sentry is one of the earliest peaches to ripen in the Appalachian area. While most other peaches ripen after August 1, growers can pick Sentry about July 25.

"Sentry is virtually free of pit fractures, a big problem with most early peaches in the Appalachian area," Baugher explains. "Because this is not always an obvious problem, growers can lose at the time of marketing if the fruit is graded and shattered pits are found."

Sentry also grows well in New Jersey. In the six-county area where

KEITH WELLER


(K4957-13)

about 98 percent of New Jersey's peaches are grown, there are over 300 acres of Sentry peach trees, according to Jerome Frecon, an agriculture agent for the Rutgers Cooperative Extension of the New Jersey Experiment Station. He says growers plan more plantings of Sentry, since it allows harvest to begin about July 10, well before other early-season peaches mature.

"On about 12,000 acres, we harvest around 100 million pounds of peaches annually. That makes us fourth in U.S. peach production," Frecon says.

He is also excited about Bounty, a peach that Scorza released in 1989 jointly with Texas A&M Agricultural Experiment Station scientists.

"We think Bounty may replace Loring, the No. 1 variety planted by most of our growers," Frecon says. "Bounty has excellent flavor, is more winter hardy, and has more red color than Loring."

The fact that both Sentry and Bounty ship well is a big plus for New Jersey, since most of the peaches produced there are shipped out-of-state, north into Canada and to the midwestern states.

The Southern Connection

Over half, or about 760,000, of the commercial peach trees grown in central Georgia—and 20 percent of those in Alabama and South Carolina—are from ARS-developed varieties, says horticulturist Dick Okie. Georgia is the third largest peach-producing state, after California and South Carolina.

At the ARS Southeastern Fruit and Tree Nut Research Laboratory in Byron, Georgia, Okie and horticulturist Tom Beckman breed new tree fruit varieties and rootstocks for the southeastern United States.

Of the 2.7 billion pounds of peaches produced in the United States in 1993, 492 million pounds, valued at $83.7 million, came from the Southeast.

Major ARS-bred varieties responsible for this include Redglobe, Coronet, Springcrest, Juneprince, Sunbrite, Sunprince, and Goldprince.

Introduced from the ARS Beltsville breeding program in 1954,

PATRICK TREGENZA

Flavorcrest peaches. (K5632-2)

Redglobe is the most popular, with more than 400,000 trees throughout Alabama, Georgia, and South Carolina. Rising in prominence is Goldprince, with over 600 acres planted in Georgia alone since its release in 1989. Further planting is expected, since growers have seen its productivity.

"Springcrest and its relatives have dominated the early season market in California and Europe for the past 20 years," Okie notes. "Many of our varieties are widely grown in Europe and in South America and have been used as parents in foreign breeding programs."

White-fleshed peaches Starlite and Scarletpearl have caught on with many small growers that supply retail and local markets across the Southeast. These ARS varieties help fill market niches heretofore not served.

One of the newest introductions from Byron is a rootstock that resists Peach Tree Short Life. This disease kills thousands of peach trees annually in the southeastern United States, costing growers millions of dollars each year in lost production.

In a matter of months after its introduction in 1993, Beckman had requests for more than a million seeds of this new rootstock, BY520-9. Released jointly with Clemson University, it is expected to be of great value to peach producers in the Southeast and possibly throughout much of the peach-growing world.—By **Marcia Wood** and **Doris Stanley,** ARS.

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Black Emerald Seedless Grapes: A New Late-Spring Taste Treat

A luscious new grape called Black Emerald may become a favorite black seedless grape for early-summer snacks or salads.

"Black Emerald grapes are sweet, firm, and juicy," says grape and tree fruit breeder David W. Ramming, with ARS at Fresno, California. "The berries are about the size of a dime, with an attractive dark black skin. The flesh is translucent, firm, and almost crisp."

DAVID RAMMING

Black Emerald grapes. (NY5-94-2)

Ramming and ARS colleague Ronald Tarailo have scrutinized some 800 experimental Black Emerald vines over the past 6 years. The researchers made the new variety available to breeders and commercial grape growers this spring.

"Black Emerald," says Ramming, "fills a unique niche because it's ready to harvest at a time when you can't find another top-quality, U.S.-grown black seedless grape at the supermarket." It first ripens in mid-May, in the Coachella Valley of Southern California. That puts it right after Perlette—a white (actually green) seedless grape—and before Flame Seedless—the popular red seedless grape.

"Until now," he says, "the only black seedless grapes available at that time of the year were either not as good quality as Black Emerald or were imported from South America and not as fresh as locally grown fruit."

Ramming produced Black Emerald by crossing a seeded grape with a seedless type. He and Tarailo have tested experimental Black Emerald vines at more than a dozen commercial vineyards in California and in a research vineyard managed by California State University at Fresno.

California is the nation's leading producer of table, wine, and raisin grapes. The state's Table Grape Commission funded part of the ARS research.

Nurseries and breeders can order Black Emerald cuttings or young vines in 4-inch pots from the Foundation Plant Materials Service of the University of California at Davis. Ramming estimates it will take 3 to 5 years before enough vines are in the ground to market the new grape nationally.—By **Marcia Wood,** ARS.

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Breeding a Better Beer

On a hot day, many Americans partake of a big glass of barley, in the form of beer.

Barley also contributes to favorite foods that are commonly washed down with beer—hot dogs and hamburgers. Not only do buns and other breads often contain malted barley; the animals that provided the meat may also have been fed the grain. And beer, brewed from malted barley, has been enjoyed worldwide since 4,000 B.C.

USDA's commitment to barley research is also long-lived. USDA scientists began growing 13 barley cultivars in Washington, D.C., in 1866, in the shadow of the U.S. Capitol. By 1906, they had begun to study brewing qualities as well. Today, ARS scientists continue to provide crucial support to the barley and brewing industries.

"ARS is a central component in malting barley development," says Mike Davis, President of the American Malting Barley Association in Milwaukee, Wisconsin.

The grain comes in two main types: two-rowed and six-rowed. The hardy grain grows on almost every continent, from the fringes of the Sahara desert to the slopes of Mt. Everest.

U.S. farmers grow both types, primarily in North and South Dakota, Idaho, Montana, Minnesota, and Washington. About one-third of the crop is used for malting and brewing. The other two-thirds go to animal feed and seed production.

Malting is the natural process that activates enzymes in the barley. These enzymes convert the grain's starches into sugar.

Growers earned nearly $1 billion last year from the barley crop. Revenue from value-added products such as beer and animal feed, along with federal tax revenue from brewed beverages, contributed another $9 billion to the economy.

By 1936, USDA had collected over 3,000 barley specimens from around the world. The collection, held at the ARS National Small Grains Germplasm Research Facility in Aberdeen, Idaho, now contains more than 26,000 accessions of wild and cultivated barley.

ARS has developed over 40 varieties having improved agronomic and malting qualities. Even more varieties owe at least part of their genetic makeup to ARS-developed cultivars.

Klages, one of the most successful ARS varieties, has contributed to the parentage of most two-rowed malting varieties currently grown in the United States. Russell and Crystal are other ARS varieties recommended for the 1994 season by the American Malting Barley Association.

"New varieties emerge every 5 to 10 years. We are always trying to come up with a better combination of plant characteristics, as well as disease resistance and superior malting qualities," says ARS agronomist Darrell Wesenberg. He works at the Aberdeen facility and helped develop Klages, Russell, and Crystal.

Berne Jones, a chemist in the agency's Cereal Crops Research Unit at Madison, Wisconsin, leads a team that tests new barley breeding lines for qualities that will make good beer.

"The most important quality is 'extract,' or how much of the malt dissolves in hot water," says Jones. "Brewers can't use the material that doesn't dissolve."

Jones is also collaborating on the North American Barley Genome Mapping Project, looking for the locations on barley chromosomes of genes that give rise to desired malting qualities.

And ARS scientists have already begun genetically engineering the grain [See "Can Better Barley be Bred?," *Agricultural Research,* February 1994, p. 4], promising an even better cereal for the farmer, maltster, and brewer.—By **Kathryn Barry Stelljes,** ARS.

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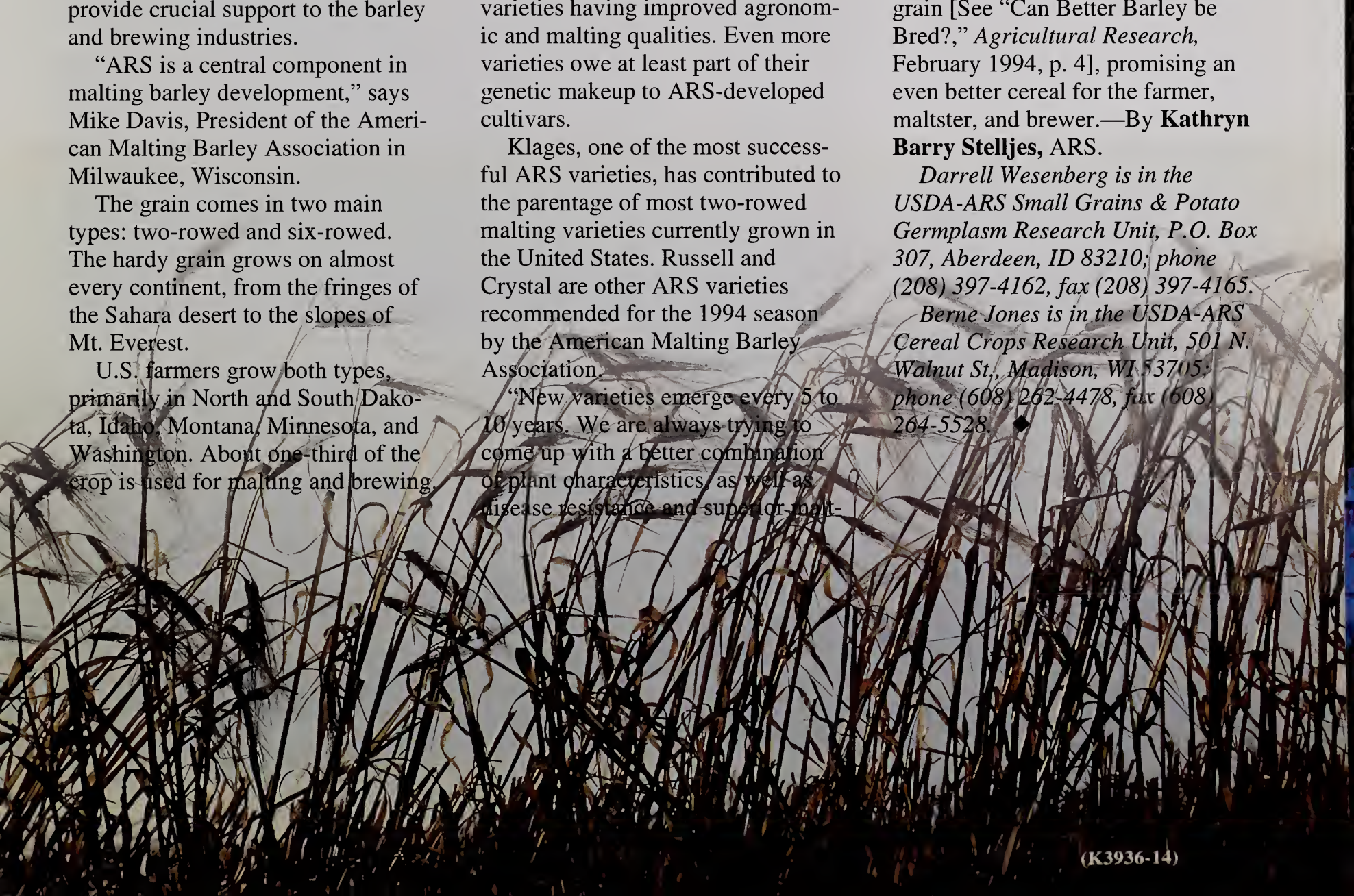

(K3936-14)

Citrus That's Clearly Superior

For year after tedious year, Jack Hearn nursed along his promising new varieties of oranges, tangerines, and grapefruit. Now that the fruit of his labor is finally out of the greenhouse and planted in citrus groves, was the 15-year wait worth it?

Just ask a few grateful growers, starting with Stan Bronson, manager of Callery-Judge Grove and a hands-on authority.

"We grow 17 different varieties of citrus," says Bronson, "and we're Florida's largest grower of Sunburst, Fallglo, and Ortanique tangerines."

Covering 4,000 acres, Callery-Judge Grove is the largest single-site grower of fresh citrus in Florida. Located near West Palm Beach, it's also one of the southernmost commercial growers in the United States.

Bronson has about 240 acres of Fallglo, which is his favorite tangerine. This tangerine is so big it's often mistaken for a tangelo. "Not too sweet; not too tart: The taste of Fallglo is just right.

"And Sunburst is superior to existing fall-ripening tangerines in cold hardiness, disease resistance, and fruit quality," he says.

Hearn bred Fallglo and Sunburst at the U.S. Horticultural Research Laboratory in Orlando. And, he points out, both were targeted for the early-season market. "That's late October through early December, a market that has been dominated by Dancy, an old standard tangerine variety that is difficult to grow."

Bronson agrees. "I think that Sunburst is beginning to take over the market Dancy has held for years. Sunburst ships better, resisting bruising and disease."

And shipping is a very important consideration, Bronson knows. He ships his entire crop of Sunburst tangerines, harvested from 200 acres, primarily to California.

Though famous for its navel oranges, California grows very few tangerines.

Released in 1979 and 1987, Fallglo and Sunburst are just two of the seven citrus varieties that Hearn has developed and released over the past 15 years.

"Hearn made new varieties available to growers at a critical time. We faced the challenge of replanting large acreages killed by successive freezes," say Bobby F. McKown, executive vice president of Florida Citrus Mutual, an organization that helps more than 12,000 citrus growers produce and market their crops.

"Over the last few years, market changes brought on by foreign competition have increased the need for new, improved citrus varieties. Hearn's innovative research has given us higher yielding varieties with increased disease resistance, better color, longer shelf life, and improved cold tolerance."

According to Robert E. Barber, Citrus Mutual's director of economics, Florida growers produce about 250 million boxes of citrus—oranges, tangerines, grapefruit, and specialty fruit—each season. Of this, about 86 percent goes into making juice and 14 percent for fresh consumption.

In short, citrus puts a lot of juice into the Florida economy. Next to tourism, it's the state's leading industry, generating about 8 billion dollars a year.

Ambersweet, Hearn's newest citrus introduction, is expected to have the greatest impact of all on the fresh citrus market because it's easy to peel and has excellent flavor. But it also produces juice with excellent color.

Ambersweet's lineage is half orange, three-eighths tangerine, and one-eighth grapefruit. The FDA recently gave this new citrus a thumbs up. FDA approval means it can be labeled as orange juice.

"Processors don't need to mix Ambersweet juice with conventional orange juice for it to meet Federal

RANDALL SMITH

Ambersweet is expected to have the greatest impact on the fresh citrus market because it's easy to peel and has excellent flavor. (94-10-3)

color standards for Grade-A juice. To the contrary, Ambersweet can be mixed with other orange juices to bring *their* color up to par," Hearn says.

Lauded as cold hardy, Ambersweet was released in 1989. By now it has been widely planted throughout Florida.

"We'll harvest our first crop of Ambersweet this year," Bronson says. His 115 acres of 4-year-old trees are heavy with fruit, indicating an excellent crop.

Ambersweet is also working well for growers with small acreages. On his 1,100 acres about 35 miles west of Orlando, Roy Hart has 90 acres in young, 3-year-old Ambersweet trees. He uses no pesticides on them and is now picking for the fresh market.

Last year he sold the crop to juice processors because the fruit needed another year of maturity to reach the delicate balance of sugars and acids acceptable for fresh consumption.

A Niche for Juice Color

Midsweet, Gardner, and Sunstar are three other oranges that Hearn introduced for both fresh and processing markets in 1987. With superior juice color, these high-yielding oranges ripen from mid-January through March.

"These oranges will fill a market niche now filled by imported juice," Hearn says.

Florida's major juice oranges—Pineapple, Hamlin, and Valencia—are not without their problems.

Many Pineapple orange trees, Florida's chief midseason variety, have been killed off by past freezes.

In 1992, about 40 percent of all grapefruit trees—as well as 72 percent of the tangerine and 7 percent of orange trees—sold by nurseries and planted in Florida were varieties developed by ARS plant geneticist C. Jack Hearn.

Hearn-Developed Citrus Being Grown in Florida Nurseries

Variety *	*Million trees*
Ambersweet orange	**5.0**
Midsweet orange	**1.0**
Flame grapefruit	**5.0**
Sunburst tangerine	**2.5**
Fallglo tangerine	**1.3**

* No estimate for Sunstar or Gardner oranges

At roughly $4 per tree, this totals about $60 million in nursery tree sales alone. Estimated annual value of fruit from these varieties is $50 million, or more.

Early-season Hamlin ripens from late December to early February; the late-season Valencia, from April through May. Part of the need for imported juice arises from Hamlin's insufficient color, which doesn't meet Grade-A juice standards. Valencia is often mixed with Hamlin juice to improve its color.

Although it has a deep, rich juice color, Valenica's fruit can take up to 14 months to mature. This means that in March, when citrus blooms, Valencia trees sport both blooms and immature fruit. And because the fruit hangs on the trees so long, it is extremely vulnerable to fluctuating temperatures and possible freezes in December and January.

But even though it takes more than a year for Valencia to mature, growers value it because the fruit has a higher sugar content and darker juice color than any other orange grown in Florida. Processing fruit is sold for its sugar content.

It's not just tangerines and oranges that Hearn has developed for Florida citrus growers. Flame grapefruit, officially released by Hearn in 1987, will be harvested for the fifth year in December.

"Flame, with its dark-red fruit color and thin peel, is becoming increasingly popular with local growers," Hearn explains. "Until now, Star Ruby has been the major dark-red-fleshed grapefruit variety."

Growers are switching to Flame because Star Ruby is susceptible to foot rot disease, lacks cold hardiness, and produces inconsistent crops.

Although he has spent about 31 years breeding citrus, Hearn is by no means resting on his laurels. He has a new orange selection almost ready for release that has potential for both the fresh and processing markets.

"This is a midseason orange with juice color similar to that of Valencia that will blend with commercial varieties," Hearn says. "It ripens between Hamlin and Valencia and would reduce processors' storage and blending costs. This new orange would make more efficient use of processing plants, since it matures between the early- and late-season oranges today grown for processing."

He is now testing this latest variety for cold hardiness and evaluating the fruit and juice.—By **Doris Stanley**, ARS.

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DOUG WILSON

Wheat harvest in Washington. (K1441-5)

With Soybeans and Wheat—
Good Breeding Has Made All the Difference

They look as different as night and day, a sturdy, fuzzy-podded legume and a thin grass dripping with grain.

Soybeans and wheat share much, it turns out. Both have been food and feed staples for thousands of years. Neither is native to this country, but each is grown on roughly 60 million acres. As our No. 2 and No. 3 crops, soybeans and wheat have a combined farm value of nearly $20 billion, plus dozens of economically important food and nonfood uses.

Most soybean and wheat varieties have "Agricultural Research Service" somewhere in their pedigrees. In just the years from 1980 through August 1994, ARS scientists released 70 commercial varieties and 138 breeding lines of wheat and 66 varieties and 280 lines of soybeans—often in cooperation with state and university colleagues.

About a dozen breeders now or formerly with ARS are chiefly responsible for turning soybeans into an oil and protein powerhouse in this country. From the 1940's into the 1970's, almost all soybean varieties were developed by ARS researchers Richard L. Bernard, Charles Brim, Richard Cooper, Edgar Hartwig, Kuell Hinson, Herbert Johnson, Albert H. Probst, C. Robert Weber, James Wilcox, and Leonard Williams.

"Their varieties were foundation stones for today's extensive private soybean breeding industry," says Charles F. Murphy, the agency's national program leader for grain crops. Plentiful, high-protein soy meal from high-yielding, disease-resistant soybean varieties made possible today's multibillion-dollar broiler, egg, and pork industries, he adds.

From 1949 to 1969, soybean production rose from 55 to 388 million bushels in the 14-state southeast production region primarily because of Lee soybeans, released by ARS in 1954. More recently, ARS' Forrest soybeans—with resistance to soybean cyst nematodes—prevented estimated yield losses of $400 million from 1975 to 1980.

Soybean researchers today continue to improve the germplasm base, the bean's protein content and oil quality, the plant's ability to supply its own nitrogen and to resist pests, and many other traits.

Still, the potential of characteristics in some newer varieties is largely untapped. For example, daylength ordinarily limits a soybean farmer's planting window to 6 weeks or less. The plant grows foliage when days are long, shifting to seed as days shorten. But two recent ARS varieties—Vernal (1993) and Padre (1988)—have windows of at least 3 and 6 months, respectively. Other lines of this type of soybean, known as the long-juvenile genotype, are in breeding programs.

To create future varieties, plant explorers collect new germplasm and

breeders re-collect from the past by drawing from repositories—living storehouses of plant genes.

The ARS soybean germplasm repository in Urbana, Illinois, has more than 15,000 accessions. It sends out about that many seed samples every year to fill requests from around the country and the world, says curator Randall Nelson.

Updating an Old-Timer

World War II's end marked the soybean's emergence as a major food, feed, and oil crop in the United States. It also marked a rebirth for wheat, a crop in its fourth century here. Although wheat yields had continued to rise, the plant often proved too weak to hold the heavy load of kernels coaxed forth under test conditions. "High yield doesn't do a farmer any good if the plant falls over and the seed is lying on the ground," says Murphy.

But in 1946, in Japan, a USDA agronomist collected something unusual: short, stiff-strawed wheat plants. Within a year, scientists in the United States began multiplying, crossing, and testing the material. Their care and patience first paid off in 1961. That's when a team of ARS and Washington State University scientists, led by the late ARS agronomist Orville Vogel, released Gaines semidwarf wheat.

Gaines and other semidwarfs shattered wheat's structural yield barrier and opened new areas to production. They were the resilient, living sparks of the global Green Revolution.

"The semidwarfs are unique in that they're an offensive strategy rather than a defensive one," Murphy says. "Typically, you increase wheat yield by breeding in defenses to pests" such as septoria, rust, Hessian fly, and Russian wheat aphid.

Two disease-resistant spring wheats dominated in Minnesota in the 1970's and 1980's. "Era spring wheat gave Minnesota growers a 25-percent yield increase worth $300 million from 1973 to 1983. It was grown on as much as 80 percent of the state's wheat acreage," says Robert Busch of ARS' Plant Science Research Unit in St. Paul. ARS developed Era in cooperation with the Minnesota Agricultural Experiment Station.

SCOTT BAUER

Most soybean varieties have the Agricultural Research Service in their pedigree. Agency scientists have released 66 varieties and 280 breeding lines between 1980 and August 1994. (K4389-11)

In 1984, Era was bumped by another offering from the cooperative breeding program. Marshall spring wheat led the state from 1984 to 1991. It became No. 1 throughout the U.S. spring wheat region—planted on more than 5 million acres a year—in the mid to late 1980's.

In the East, about 25 wheat varieties released by the ARS-Purdue University program since 1946 have accounted for over 70 percent of the 15 million acres of soft red winter wheat. They raised farm income by more than $6 billion compared to varieties they replaced, says ARS scientist John J. Roberts, now in Griffin, Georgia.

The Great Plains grows more than 25 million acres of wheat, much of it from varieties bred by ARS and university cooperators. An example is the highly winter-hardy and rust-resistant Arapahoe, released in 1989 by ARS and the University of Nebraska. Arapahoe jumped from 2 to over 30 percent of Nebraska's wheat acres in 3 years, says C. James Peterson, who is with ARS in Lincoln.

Almost all commercial Pacific Northwest wheats have disease resistance that breeders borrowed from a single wheat specimen that ARS scientist Jack Harlan (now retired) collected 46 years ago in Turkey.

This Turkish wheat and 43,000 other accessions are stored—and shared—by ARS' National Small Grains Collection in Aberdeen, Idaho. To develop the first breeding line released in this country for resistance to the Russian wheat aphid, ARS scientists used an Aberdeen accession originally from Saratov, Russia. It arrived in the United States in 1944—the year after Nikolay Vavilov, the "father" of Soviet germplasm collections, died in a Stalinist camp in Saratov.

It's unknown if this accession is a legacy of Vavilov, but the mystery underscores that what we eat today and tomorrow has deep roots in the past.—By **Jim De Quattro, ARS.**

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JOHN CROSS

At a groundbreaking ceremony for the new Center of Excellence in Nursery Crops, Ed Porter (left), president of Triangle Nursery, Tennessee State University president James Hefner (center), and ARS administrator Dean Plowman discuss nursery stock from McMinnville nursery. (94-l0-1)

USDA Bolsters Science at 1890 Schools

Now under construction on an 87-acre nursery plot at McMinnville, Tennessee: the first of 16 Centers of Excellence planned for 1890 historically black Land-Grant institutions throughout the country.

The $3.4 million, 15,847-square-foot research station will house Tennessee State University (TSU) and ARS scientists working on breeding new varieties of landscape trees and shrubs, developing biocontrols for insect pests, and testing new techniques for propagating, irrigating, and storing nursery crops.

It's just one part of a new program to forge partnerships between the federal government and 1890 schools such as TSU.

"This is the first plan in ARS to have scientists stationed at an 1890 Land-Grant institution," said ARS Administrator R. Dean Plowman at the March groundbreaking ceremony.

He was joined at the ceremony by Senator James Sasser, TSU president James A. Hefner, administrative staff for TSU's Cooperative Agricultural Research Program, representatives of the Tennessee and U.S. nursery industries, and the family of the late Dr. Otis L. Floyd—the former TSU president who coordinated federal, state, and industry support for the McMinnville research station.

"Dr. Floyd believed that with a little bit of foresight, and with a dollar and a deed, we could indeed transform this ground into a nursery crops research station that we could all be proud of," says TSU Dean of Agriculture and Home Economics Troy Wakefield, Jr. "In Dr. Floyd's words, it would be our niche that would bring us to national—indeed international—stature."

The USDA's Centers of Excellence program was begun 2 years ago by the USDA/1890 Land-Grant Universities Task Force. The goal was to bolster the capacity of 1890 schools to contribute to the American food, fiber, and agriculture system—primarily through cooperative research, technology transfer, and outreach service to agroindustries.

Korona Prince, ARS director of Equal Employment Opportunity, says the Centers of Excellence program falls under the USDA/1890 Initiative—begun in 1989 to facilitate development of partnerships between the 1890 schools and USDA.

As part of the initiative, says Prince, a $10-million, congressionally appropriated Capacity Building Grants program provides summer internships and other educational opportunities for students pursuing careers with USDA agencies including ARS, Soil Conservation Service, and the U.S. Forest Service.

Other USDA Centers of Excellence planned for 1994-95 include a Forestry and Biotechnology Center with Alabama A&M University at Normal; Centers on Aquaculture and on Regulatory and Risk Analysis with the University of Arkansas at Pine Bluff; a Food Safety Center with the University of Maryland-Eastern Shore at Princess Anne; a Wildlife and Geographic Information Science Center with Lincoln University at Jefferson City, Missouri; and a World Food Distribution Training Center at Prairie View University, Texas.

The nursery industry in McMinnville and its surrounding areas, one of the country's oldest and largest, generates over $320 million in wholesales each year. In Tennessee, nursery crops rank second only to cotton in value.

At the new center's groundbreaking ceremony, Plowman noted that McMinnville is ideal because it's

located in the heart of a nursery industry that supplies crops to all 50 states, Canada, and about 20 foreign countries. Nursery crops typically include shade trees, ornamental shrubs, fruit and nut trees, groundcovers, and ornamental grasses.

"We do a lot of things in the laboratory, but results eventually have to be moved into the field and discussed with people who grow these plants," Plowman says. "As the nursery industry becomes more efficient, it can pass on that efficiency as lower prices to consumers who buy nursery crops."

According to TSU's Wakefield, Floyd envisioned the nursery site at McMinnville as being ideal for a research station. The community is in a mid-state region that is characterized by varying soil types, a temperate climate, an average 55-inch rainfall, some 150 species of deciduous trees and shrubs, and a thriving nursery industry that dates back to the 1880's.

"We're in a transition zone between South and North, so we can grow plants that do well in the South, just as we can grow plants that do well in the North," McMinnville nurseryman Ed Porter says of the region, comprising mainly seven counties.

Porter is among several thousand nursery growers belonging to the American Association of Nurserymen in Washington, D.C., and the Tennessee Nursery Association, headquartered at McMinnville—organizations that assisted TSU and the State of Tennessee in identifying areas of research need.

Some of those include marketing surveys, methods of propagating native wildflowers, and substances that could delay blooming of northern-bound crop varieties like magnolias, cherries, and pears.

"I want to see breeding work to develop new varieties that have not only ornamental value, but food value as well," says nursery grower Don Shadow of Winchester, Tennessee.

Growers also cited research to identify biocontrol organisms that might fill gaps left by increasing Environmental Protection Agency restrictions on certain chemical fungicides and pesticides.

"If we can cut in half the amount of chemicals that we're using today," notes nurseryman Frank Collier of Rock Island, Tennessee, "the $3 or 4 million [cost of the station] will be well worth the money spent just for that alone."

Currently, research at the station's temporary facilities includes an evaluation program for flowering dogwood and landscape plants funded by two Capacity Building Grants awarded to TSU plant pathologist Roger Sauve.

Sauve and collaborating University of Tennessee scientists from Knoxville are breeding new dogwood cultivars that resist anthracnose, a disease of native dogwood caused by the fungus *Discula destructiva*.

First reported in 1978 in New York, anthracnose spread throughout the Appalachian region. TSU station director Bill Butt notes that Tennessee's dogwood sales—estimated at $48 million in 1990—have declined because of quarantine restrictions in affected states and consumer concerns over whether the trees can survive an attack by the disease.

ROBERT BJORK

Flowering dogwood. (94-10-4)

Once completed, says Butt, the station's field plots and 7,200-square-foot greenhouse would complement dogwood work and other nursery research already underway at TSU labs in Nashville.

As part of USDA's Centers of Excellence program, ARS has allocated funds for two ARS scientists at McMinnville this year, says Howard J. Brooks, ARS' associate deputy administrator for plant sciences.

ARS scientists will work with TSU researchers in a team approach to solving nursery crop problems, Brooks says. That cooperation will also include evaluation and development of new varieties of landscape trees and shrubs using germplasm from the U.S. National Arboretum in Washington, D.C.—By **Jan Suszkiw**, ARS.

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Small Fruits Make It Big

It's a family affair. George and Shirley Butler, their daughter Susan, and sons Todd and Wade operate Butler's Orchards near Germantown, Maryland.

On 150 acres of lush, gently rolling farmland about an hour's drive from Washington, D.C., the Butlers grow pick-your-own small fruit crops. Shirley is considered the general overseer, while George and Susan take care of the strawberries. Todd runs the blueberry operation, and Wade is responsible for blackberries and other crops grown by Butler's Orchards. Besides berries, they grow broccoli, tart cherries, pumpkins, and Christmas trees.

In addition to pick-your-own, the Butlers also offer some of their produce at a farmer's market on their property.

"People come from miles around to pick our strawberries," says Susan, family-appointed spokesperson. "Our customers are always asking for Earliglow, our most popular strawberry. It's sweet and juicy and tastes wonderful. Quite a few get eaten as they're picked, because it's just so hard to resist their aroma."

SCOTT BAUER

George Butler, owner of Butler's Orchards, and his daughter Susan harvest blueberries on their farm near Germantown, Maryland. (K5603-18)

On 20 acres devoted to strawberries, the Butlers also grow Lester and Allstar, both Junebearing strawberries. Along with Earliglow, these two varieties were introduced to the strawberry industry by Gene J. Galletta, a plant geneticist with the ARS Fruit Laboratory in Beltsville, Maryland, in cooperation with the University of Maryland. Galletta and plant pathologist John Maas have spent years on research to ensure a strong and viable strawberry industry.

In addition to Junebearing (one-crop) and everbearing (two-crop) varieties, they have introduced day-neutral strawberries that bear fruit in the spring, summer, and well into the fall. Two of these, Tribute and Tristar, have created new market opportunities for Northeast strawberry growers.

"Gene Galletta's varieties have extended our strawberry season by a week to 10 days," Susan says. "Dad has been growing USDA-bred strawberry varieties for more than 30 years. We find them to be productive, with few fungal and bacterial leaf problems."

The Butlers belong to the North American Strawberry Growers Association (NASGA), a grower organization that helps fund research to improve strawberry production.

Executive Secretary J.W. Courter says that most strawberries are grown in California and Florida, where growers depend on research done by university scientists and plant breeders hired by private research organizations.

However, he says that most of the 500 NASGA growers are in the eastern and midwestern United States. They have smaller acreages and depend more on USDA for help with improvements like disease resistance and productivity.

These growers use the crop as an alternative crop, or pick-your-own. Strawberries are the first income crop these growers harvest each year, which makes them very important.

Courter says, "In the 1950's, USDA actually saved the strawberry industry in Illinois, Indiana, Michigan, and Ohio by releasing Surecrop along with Stelemaster and Sunrise, the first strawberry varieties resistant to several races of red stele. Before resistance was available, the appearance of this root-rotting fungus meant that strawberries had to be moved to virgin fields to avoid contamination.

Courter estimates that 3 of every 4 acres of strawberries grown in Illinois are from the USDA breeding program, and he thinks this is probably true for other states in the Midwest as well

ARS scientists are still fighting another major strawberry disease—anthracnose. This fungus causes rot on the berries and black spots on the stems and foliage. It may also kill plants if it infects the plant's crowns or stems just above the soil line.

"Anthracnose is the primary cause of crown rot and plant death in Florida and Louisiana and has been reported in California, Ohio, and in most southeastern states," says plant pathologist Barbara Smith.

Based at the ARS Small Fruit Research Station in Poplarville, Mississippi, she and plant geneticist Creighton L. Gupton screen up to 40,000 strawberry seedlings a year for resistance to anthracnose. They have just released four strawberry breeding lines that resist this major fungal disease.

The new lines, originally developed in Maryland by Galletta, produce large, bright-red, high-quality berries. Because these plants also resist other diseases that plague strawberries, they can be grown with less pesticides.

KEITH WELLER

Sweet, juicy strawberries not only taste good; they're also full of nutrition. Low in calories and carbohydrates, the raw fruit is a good source of fiber, potassium, iron, and vitamin C. (K3905-1)

Blueberry Production Expands Into the South

It began in 1908. From crossbreeding wild native plants, USDA botanist Frederick V. Coville in Beltsville, Maryland, coaxed and nurtured the first cultivated blueberry crop.

Today, about 86,000 tons of blueberries are produced on 36,000 acres by U.S. growers each year. In high demand for local and national fresh and processing markets, blueberries are also exported to Europe and Asia.

Weymouth, Burlington, Berkeley, Bluecrop, Blueray, Collins, Coville, Earliblue, and Herbert are blueberry varieties bred by Coville that are still in commercial production today.

In cooperation with state and federal researchers, more than 45 blueberry varieties were released by Coville and George M. Darrow, Donald H. Scott, and Arlen D. Draper, his successors at Beltsville.

"Highbush blueberry varieties bred for the northern United States have greater winter hardiness," explains Gene Galletta. "They're also drought and disease resistant and can be mechanically harvested."

New varieties of rabbiteye blueberries, a species native to the South, developed by ARS and southern state agricultural experiment stations, provide the foundation of an industry that is expanding in the Southeast.

Fifteen years ago, blueberries were practically nonexistent in the Gulf States. Today, over 10,000 acres are grown in the South, with more than 4,000 acres thriving throughout Texas, Louisiana, Mississippi, and Alabama.

"We introduced blueberries to growers with small acreages, and the region now has a thriving blueberry industry," says ARS horticulturist James M. Spiers, who is at Poplarville. "By introducing early-ripening varieties like Cooper and Gulfcoast, ARS scientists have extended highbush blueberry culture into the Gulf South."

Adapting blueberries for the South and for soils that are heavier, less acidic, and lower in organic matter than native blueberry soils is a major breakthrough that extends the range of blueberry production.

Genetic engineering is expected to bring another major breakthrough. ARS molecular geneticist Lisa J. Rowland, Beltsville, Maryland, is working on a genetic map for blueberries that will help determine the plant's resistance to stress. Results from this research are expected to further increase the areas where blueberries can be successfully grown.

Thornless Blackberries—a USDA First

Remember Grandma's blackberry cobbler smothered with heavy whipping cream? Customers at Butler's Orchards can make their own from luscious blackberries they pick themselves. On 5 acres, the Butlers grow Thornfree, Hull Thornless, Dirksen Thornless, Chester Thornless, Black Satin, and Smoothstem—blackberries developed by Galletta and his ARS predecessors.

"USDA blackberry breeders introduced the first truly genetic thornless

SCOTT BAUER

Harvesting blackberries at Butler's Orchards, Don Deichman works as a project planner, as well as in the fields. (K5612-1)

blackberries—Thornfree and Smoothstem—to the eastern United States in 1966," Galletta says.

From these, several new blackberries developed by Galletta and cooperators enabled growers from mid-Atlantic to midwestern states to establish pick-your-own and roadside enterprises. Chester Thornless, Galletta says, has become the most popular.

"Chester produces large harvests of big, sweet, deep-colored, flavorful berries that ship well," he says. Its vigorous plants resist heat, drought, and some fungal cane diseases.

Extremely popular from northern Virginia to Illinois, this variety has established blackberry markets in Washington, Oregon, and California.

Nearly all the blackberries that are frozen or made into jams and jellies are grown in Oregon. Marion, released by USDA in 1956, is the most important blackberry variety in the world. Grown on about 3,100 acres in Oregon, its value as a processed crop was $14.2 million in 1992.

The Pacific Northwest is the largest red raspberry production area in the world. Historically, Willamette (a 1943 USDA release) has been the main variety, but it's gradually being replaced by newer varieties. In 1993, still accounting for 40 percent of the red raspberry acreage in the Pacific Northwest, Willamette produced, on 5,000 acres, 31 million pounds of fruit worth $21 million.—By **Doris Stanley**, ARS.

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SCOTT BAUER

Chipeta! A New Chipping Potato

Chipeta, a newly named potato variety, was bred for its chipping quality. (K5448-6)

The next bag of crisp potato chips that you buy at the supermarket may be made from Chipeta, a newly named potato variety. Chipeta is the work of potato breeder David G. Holm at Colorado State University, ARS colleagues Joseph J. Pavek and Dennis L. Corsini, and Stephen L. Love at the University of Idaho.

The potato makes light, flavorful, attractively colored chips that are remarkably free of defects such as bruises, burnt edges, or unwanted bubbles that can sometimes form during deep frying.

Chipeta is backed by more than 10 years of testing by growers and researchers and several years of chipmaking by some of America's largest producers of snack foods. It's already being grown in Colorado, Idaho, Arizona, California, Nebraska, North Dakota, and Minnesota, says ARS' Pavek.

"Chipeta has been a very good potato for us; so far it appears very promising," says Brian King, who purchases potatoes for snackmaker Frito-Lay at the corporation's Bakersfield, California, chip processing plant.

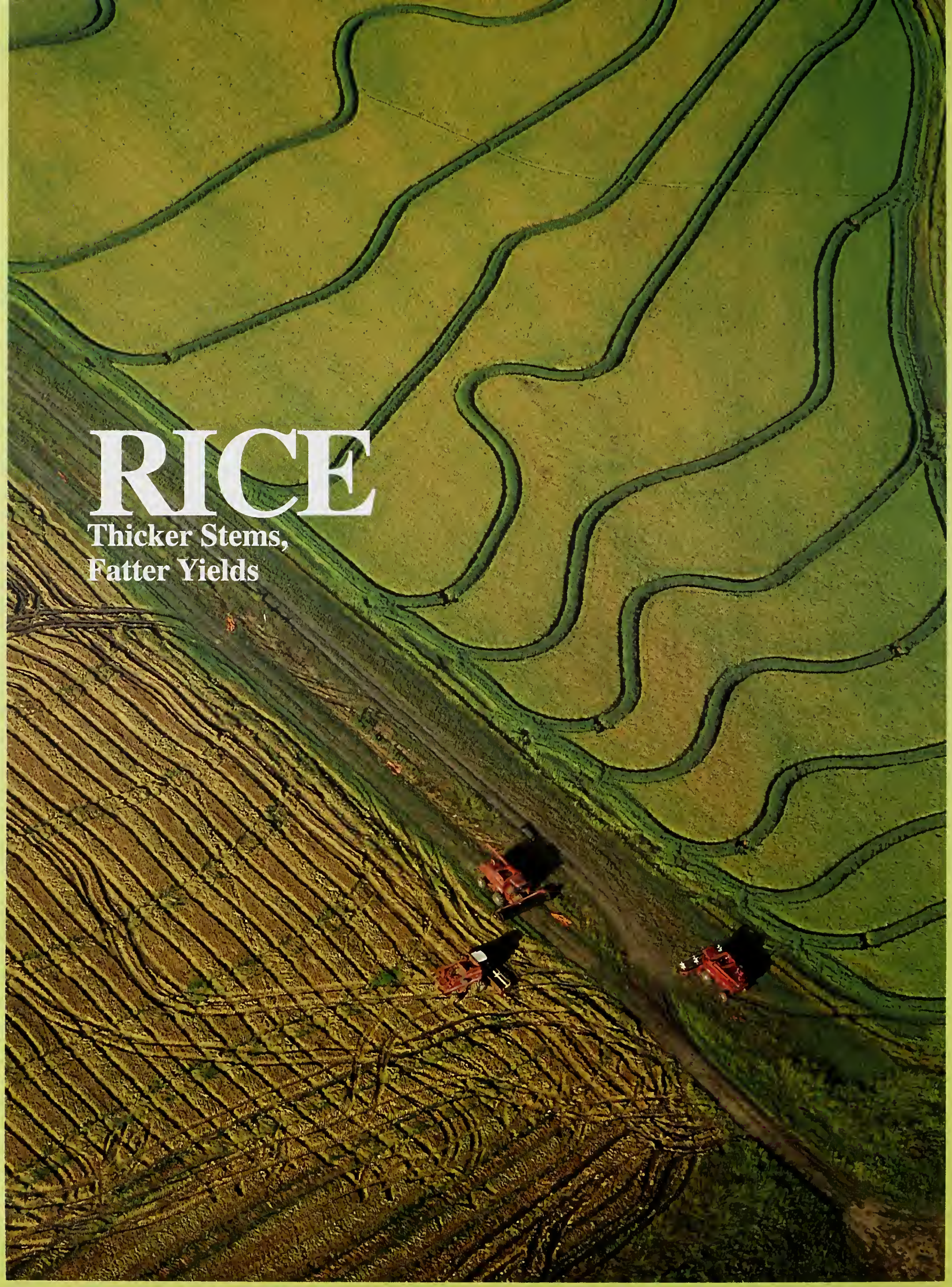
At R and G Potato Company, Inc., Idaho's largest marketer of potatoes to the potato chip industry, company president Garn Theobald has worked with Chipeta for 6 years as an experimental variety. "Its quality is absolutely super," says Theobald. "Probably the key to Chipeta's value is that it's good in cold storage. Varieties that don't store well can form sugars that caramelize during frying and make the chips look burnt."

Chipeta's other winning traits include its high starch content, high yields, and modest need for nitrogen fertilizer. High starch means chips absorb less oil during frying.

Chipeta yields per acre usually top those of standard varieties like Atlantic and Norchip. And Chipeta's minimal requirement for nitrogen fertilizer reduces the load of this chemical that could inadvertently end up in underground water supplies.

Several seed growers have Chipeta for sale to farmers; researchers can get a supply from the scientists.—By **Marcia Wood,** ARS.

Dennis L. Corsini and Joseph J. Pavek are in the USDA-ARS Small Grains and Potato Germplasm Research Unit, P.O. Box AA, Aberdeen, ID 83210; phone (208) 397-4181, fax (208) 397-4311. ◆



RICE

Thicker Stems, Fatter Yields

When the sun goes down on another day in Bangladesh, for much of the local population there's no great debate about what sounds good for dinner. As recently as 1990, three out of every four calories consumed in that country came from a single source: rice.

In Asia, rice contributes 35 percent of total calorie consumption; in Latin America it provides 10 percent.

That's important market news for American farmers, who grow nearly 1 of every 5 bushels of rice moving on the world market. And when it comes to the varieties of rice those farmers grow, the Agricultural Research Service, in cooperation with university scientists, has been a fertile source of promising new products.

In 1993, a single ARS-developed semidwarf rice variety, Lemont, covered 600,000 acres in Arkansas, Louisiana, Mississippi, and Texas—24 percent of the region's total rice acreage, with an estimated farm value of about $248 million.

That same year, ARS' semidwarf Gulfmont contributed another 147,000 acres with an estimated farm value of about $61 million.

Together, Lemont and Gulfmont accounted for nearly 30 percent of rice in the four states.

"When Lemont was released in 1983, it changed the face of the rice industry in the southern United States," says ARS research geneticist Anna M. McClung, based at the agency's Rice Research Unit at Beaumont, Texas. "Today, both Lemont and Gulfmont are considered standards in the industry.

"Lemont was the first high-yielding semidwarf rice variety that matured early and had high milling yields," she points out. "Lemont has also been used heavily as a parent in other varieties."

Semidwarf rice varieties are favored by farmers, in part, because the plants' thicker stems are less likely to bend under their load of grain and dump their bounty on the ground—a problem known as lodging.

DAVID NANCE

Lemont was the first high-yielding semidwarf rice variety that matured early and had high milling yields. (K2958-2)

Outstanding as Lemont has been, its cousin Gulfmont brought special qualities of its own to the marketplace with its release in 1986.

"Gulfmont actually has better second-crop potential than Lemont," says McClung. "That's where you plant the rice early, harvest the crop, water and fertilize the stubble that's left in the field, and get a second harvest from the sprouts that grow.

"In 1991, we released Rosemont, which has the highest total yield if you count both its first and second crops—8,000 pounds of rice per acre, versus 6,000 pounds from one main crop."

This concept of collecting twice on a single planting was the impetus behind Maybelle, released by ARS in 1989. Both Maybelle and Rosemont were derived from crosses in ARS genetics programs at Davis, California, in 1978.

"Maybelle is the earliest maturing variety on the market, ready in 105 to 110 days, plus it has good yields and good milling quality," notes McClung. "In 1993, it was grown on 151,000 acres in the southern United States, about 6 percent of the region's total rice acreage."

Other promising varieties from ARS include:

- Texmont, a 1990 release noted for its early maturity, lingers in the field only about a week longer than the speedy Maybelle. Texmont holds the distinction of being the first rice variety developed from tissue culture—a technique that allows development in the laboratory of an entire plant from just a small fragment of plant tissue.
- Dellmont, a 1991 release with popcornlike flavor. Currently grown on very limited acreage in the South, Dellmont came from backcrossing Lemont with Della, an aromatic rice developed by ARS rice breeder Nelson E. Jodon at the Louisiana Agricultural Experiment Station at Crowley. Jodon, who died in 1993, worked in rice breeding there from 1933 to 1983, producing the Magnolia, Sunbonnet, Doro, Lacrosse, Nato, and Saturn varieties—in addition to Della, a leading aromatic long-grain rice now grown in the United States.

Under the leadership of Beaumont-based plant breeder Charles Bollich, now retired, ARS also brought forth Labelle, the first early-maturing rice for the United States, released in 1972, and Rexmont, a semidwarf long-grain with outstanding cooking qualities, released in 1986. In all, 26 varieties emerged

Rice harvesting in Fort Bend County, Texas. Photo by David Nance. (K5634-1)

DAVID NANCE

ARS plant breeder Charles Bollich (retired) inspects Lemont rice near Nome, Texas. In 1993, this one ARS-developed variety covered 600,000 acres in Arkansas, Louisiana, Mississippi, and Texas—24 percent of the region's total rice acreage. (K2959-20)

from the Rice Research Unit between 1942 and 1991.

These days, McClung is turning her attention in a different direction: disease resistance. "Over the last 3 years, sheath blight and blast have devastated the rice crop in the southern United States," she says. "However, we've found a lot of disease resistance in varieties from Asia. While these Asian varieties aren't the quality of rice we want, we will try to incorporate the resistance into varieties we prefer in this country."

In addition to the breeding program at Beaumont, ARS operated a rice breeding program at Stuttgart, Arkansas, for more than 50 years—until rice breeder Ted H. Johnston retired in 1982.

Among Johnston's notable successes was Starbonnet, released in the mid-1970's. It was for many years considered the standard for long-grain rice in Arkansas, the nation's leading rice-producing state. After Johnston's retirement, the rice germplasm he left in the breeding pipeline was released in the form of several varieties by the University of Arkansas rice breeding program.

ARS also made significant contributions to rice germplasm in the form of Calrose 76, released in 1976 as the United States' first semidwarf table rice variety. Unlike rice used for brewing or incorporation into snacks or pet foods, table rice is only lightly processed. Calrose 76 was followed in 1979 by M-101, a semidwarf variety that matures about 2 weeks earlier than Calrose 76, making it a good choice for cool areas with a shorter growing season.

While neither Calrose 76 nor M-101 is grown today as a distinct variety, both have been widely used in the rice industry's breeding programs. Calrose 76 is the semidwarf donor not only for M-101, but also for eight other semidwarf varieties that in the early 1980's were grown collectively on as much as one-third of California's rice acreage.

"The gene for semidwarf rice in the United States really comes from two sources," notes J. Neil Rutger, an ARS rice geneticist now based at the agency's National Rice Germplasm Evaluation and Enhancement Center at Stuttgart, Arkansas. "One of these sources is Calrose 76, and the other is the tropical semidwarf source that appears in Lemont and other varieties.

"Incorporating semidwarfing into rice varieties from the tropical source can take up to 10 years," says Rutger. "But Calrose 76's semidwarf gene is an induced mutant from the rice variety Calrose, a mainstay of the California rice industry for many years. To produce this mutant, we irradiated Calrose seeds with gamma rays, which changed the seed's DNA and ultimately converted tall plants into semidwarfs.

"This mutant gene enabled us to get the semidwarf component into varieties in just 6 years, giving us semidwarf rice varieties in California with yields averaging 15 percent higher," Rutger concludes. "This is an example of where germplasm improvement programs have provided a foundation for industry development of many additional varieties."

—By **Sandy Miller Hays**, ARS.

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That Gray Melon From Charleston

It's one of a continuing string of successes from the U.S. Vegetable Laboratory.

There was a time, a half-century ago, when a good watermelon was hard to find in the local grocery.

In the 1940's, the mainstay of today's summer barbecues and seed-spitting contests was susceptible to disease and breakage during shipping. Melons in those days tasted good, but they often had soft rinds and cracked during the rough ride from farm to market. Watermelons were also round, making them hard to stack.

If you wanted a good watermelon, your best bet was to grow it in your garden.

Then along came C. Fred Andrus, a plant breeder who set out to develop a better watermelon—one that could be stacked and shipped, resist disease, and still taste good. In the late 1940's, Andrus began that task at what is today the U.S. Vegetable Laboratory in Charleston, South Carolina.

ARS

Charleston Gray watermelon. (94-10-2)

In 1954, after years of breeding, Andrus came up with a winner. He released what was then called "that gray melon from Charleston." Formally called Charleston Gray, it dominated the world market for more than two decades, turning up everywhere from Australia to China.

Charleston Gray is one of those classic plant breeding success stories—one of many over the years in ARS. Charleston Gray combined everything in one package. Its oblong shape and hard rind made it easy to stack and ship. Its adaptability meant it could be grown over a much wider geographical area than earlier melons and still produce high yields. It was resistant to the most serious watermelon diseases, anthracnose and fusarium wilt. And it tasted good, being high in what breeders call soluble sugars—the heart of what gives a watermelon its sweet taste.

There's no telling how many Charleston Gray seeds have been planted over the last 40 years. One seed company executive estimated several years ago that his company had sold 450,000 pounds of Charleston Gray seed. At about 4,000 seeds to a pound, that's a possible 1.8 billion watermelon plants! And that's only one seed company's sales. ARS melon breeder Perry E. Nugent estimates that up to 5 million pounds of Charleston Gray seed have been sold since its release 40 years ago.

In the early 1960's, August Kehr, who then headed the USDA Vegetable Research Division at Beltsville, Maryland, estimated that Charleston Gray constituted 95 percent of the domestic watermelon crop. He also said that if profits from the melon had gone directly to ARS, they would have been enough at that time to pay for the Charleston lab's operations for 50 years—until 2023.

Like many fruit and vegetable varieties of yesteryear, Charleston Gray has lost ground to new hybrids. But, as recently as 1991, 47 of 230 seed catalogs still sold it, according to the Garden Seed Inventory, published by the Seed Savers Exchange of Decorah, Iowa. And even if Charleston Gray doesn't dominate the market like it once did, "there is hardly any watermelon variety grown today that doesn't have some Charleston Gray in its lineage," Andrus says.

Andrus, who retired in 1970, also had a hand in developing the cantaloupe Mainstream, in cooperation with Nugent and retired breeder J.C. Hoffman. Nugent recalls the day in 1969 when Andrus gave him 4,000 packets of melon seed. Andrus hadn't had time to evaluate the seed and, since he planned to retire the next year, gave the packets to Nugent, saying that "there might be something here."

Nugent planted the seed and discovered that, indeed, there was something there. That "something" turned out to be Mainstream, which—in the opinion of some melon aficionados—is the best-

tasting cantaloupe ever bred. Mainstream's disease resistance and yields were also high. It averaged 37,000 kilograms per hectare (33,000 pounds per acre) in field trials in the South, 26 percent more than top varieties grown at that time.

Perhaps the hottest variety (in popularity and taste) to come out of Charleston in recent years is a cayenne pepper called Charleston Hot [See "New Cayenne Pepper Available," *Agricultural Research,* February 1993, p. 19].

After its release in 1992 by breeders Richard L. Fery and Philip D. Dukes, the lab was inundated with calls and letters from people asking for seed. Laboratory Director Claude E. Thomas estimates that the lab received 28,000 requests for seed in 1993, before the South Carolina Foundation Seed Association took over answering requests in 1994.

Michael Watkins, executive vice president of the association, says his organization sent out 10,000 packets of seed during the first 5 months of the year. "For some reason, this pepper received more media coverage than any other seed I've ever seen in my life," Watkins says, adding that several companies are also expected to offer Charleston Hot in their catalogs.

Other varieties released from the ARS breeding program at Charleston that have had an impact include:

• Provider (1965) and Contender (1949) snap beans. Contender averaged 198 bushels per acre in 1948 field tests, 25 percent more than a leading variety at that time called Stringless Black Valentine. One of Contender's key qualities was its resistance to common bean mosaic virus, which took its toll on Stringless Black Valentine and many other southern snap beans. Contender also matured earlier and yielded a second

ROB FLYNN

Sweetpotato varieties bred by ARS researchers at the U.S. Vegetable Laboratory at Charleston, South Carolina: (top to bottom) Southern Delite, Regal, and Excel. (K3388-7)

crop and better profits than other varieties at that time.

Provider also had resistance to the common bean mosaic virus and others, including the pod mottle virus, and to powdery mildew. Over 9 years of testing in the South, Provider averaged 280 bushels per acre, ranking first in overall performance in 6 of the years and second in the other 3 years of field trials.

• Wando, a pea released in 1943, is heat tolerant, making it ideal for growing in the South. As recently as 3 years ago, 76 seed catalogs still listed Wando—more than any other Charleston variety (see sidebar).

• Bettersnap (1994), Bettergro (1991), and Bettergreen (1991) are the newest southern pea releases to come out of the lab. Fery says Bettersnap was increased this spring by a leading southern seed company for production and processing this fall. Bettergro is being retailed by the South Carolina Foundation Seed Association. Bettergreen was processed last year "with excellent results" by the leading seller of frozen southern peas and is being processed under the company's "Cadillac" label in 1994.

• Homestead, a tomato released in the 1950's, was the No. 1 fresh market tomato for more than a decade after its release. Like Charleston Gray and Mainstream melons, it has also been used by private companies to develop hybrids now available in most seed catalogs.

• Carolina Bunch (1992) is the latest in a long list of multiple-disease- and insect-resistant sweetpotato varieties released by the lab over the last decade. Carolina Bunch is a compact plant designed for the smaller confines of the home garden, according to Dukes. Other orange-fleshed varieties with this resistance that have made inroads in the market are Excel (grown on more than 5,000 acres in 1993), Regal, Resisto, and Southern Delite [See "Breeding Super Sweetpotatoes," *Agricultural Research,* Nov. 1989, pp. 24-25].

Dukes says that because of their unique resistance to insects and diseases, many of these varieties and other elite sweetpotato breeding lines from the lab have been distributed to sweetpotato breeders worldwide.—By **Sean Adams,** ARS.

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Cataloging the Seed Catalogs

One of the best ways to gauge the economic impact of a crop is to check its availability in seed catalogs.

For proprietary reasons, seed companies usually won't divulge how many pounds—or how many dollars' worth—of seed they've sold. But if a seed company continues to carry a particular seed in its catalog over the years, it's logical to assume that there's still interest in that variety among gardeners and farmers.

One publication that tracks seed catalog offerings is called the Garden Seed Inventory, published by Seed Saver Publications of Decorah, Iowa. Essentially, it's a catalog of seed catalogs that has tracked the popularity of seeds since 1981. The next edition is scheduled for late 1994, according to Steve Demuth, an editor of the inventory.

Take the Charleston Gray watermelon as an example. In 1981, 65 seed catalogs carried it; by 1991, the number still was 47 even though newer, improved hybrids continue to come on the market.

The following chart tracks the popularity of some of the vegetable varieties developed at ARS's U.S. Vegetable Laboratory in Charleston, South Carolina. The chart is based on information in the directory.

Number of Catalog Entries

	1981	1984	1987	1991
Beans, Snap/Bush				
Contender	79	72	69	55
Provider	47	40	47	48
Wade	10	8	6	4
Cantaloupes				
Mainstream	3	3	6	2
Planters Jumbo	21	17	16	13
Peas				
Wando	94	84	86	76
Watermelons				
Charleston Gray	65	59	53	47
Congo	44	39	37	25
Tomatoes				
Homestead	7	4	4	7

Sweetening America's Sugarcane Industry

On bleary-eyed mornings, it's poured over cereal or into a cup of steaming coffee. It flavors jams, jellies, tomato sauces, and too many desserts to count.

In America, about 65 pounds of refined sugar are consumed per person each year—and chances are the sweet, crystallized carbohydrate came from varieties of sugarcane ARS scientists developed.

Other than sugarbeets, the commercial source of table sugar is the segmented stalks of sugarcane, a vegetatively propagated crop that normally yields two to three harvests (one per year) from a single planting.

About 1.8 million tons of America's raw sugar—one-fourth the country's total, worth about $775 million annually—are produced in Florida. Louisiana produces about 876,000 tons valued at $385 million, followed by Hawaii with about 652,000 tons worth $280 million, and Texas with about 138,000 tons worth $61 million.

The U.S. sugarcane industry's success can be traced, in large part, to sugarcane research and variety programs headed by scientists with the ARS Sugarcane Field Station at Canal Point, Florida, and the Sugarcane Research Unit at Houma, Louisiana.

Since the first variety programs started there over 70 years ago, ARS scientists and collaborating university researchers have supplied industry with 86 varieties of high-yielding sugarcane, most armed with resistance to yield-reducing diseases like sugarcane mosaic virus, eye spot, smut, rust, ratoon stunting, leaf scald, and, more recently, insect pests like sugarcane borers. "The variety programs are vital to the existence of the sugarcane industry," notes Charley Richard, Vice President of the American Sugarcane League of the U.S.A. in Thibodaux, Louisiana. "America's sugarcane industry hinges on the nonprofit involvement of state and federal agencies like ARS," he says, "because developing new varieties offers little commercial incentive to private plant-breeding firms."

SCOTT BAUER

Geneticist Peter Tai evaluates a tassel of sugarcane, *Saccharum spontaneum*, that will be used to produce seed for long-term storage in the National Seed Storage Laboratory in Fort Collins, Colorado. (K5599-8)

In Florida, sugarcane is grown on more than 440,000 acres of land surrounding Lake Okeechobee, says Jimmy D. Miller, an ARS research plant geneticist who heads the Canal Point station. Other than citrus, sugarcane is the second most-planted crop in the state.

Of 37 varieties grown commercially, 27 were developed by the station in collaboration with University of Florida scientists and the Florida Sugarcane League, Inc., at Clewiston, Florida. Miller says these varieties make up about 65 percent of Florida's total sugarcane acreage.

He says it takes between 8 and 10 years to develop a new variety using selections from about 100,000 seedlings for such traits as high sucrose content, good cane yield, low fiber, and insect and disease resistance.

ARS' free-exchange program with sugarcane breeding stations located worldwide ensures a broad genetic base from which new varieties can be developed for Florida, Louisiana, and Texas. Miller says sugarcane seed (called "fuzz") for the agency's breeding programs is produced at Canal Point, where warmer temperatures allow sugarcane to flower naturally.

All commercial sugarcane, including fuzz produced from Louisiana varieties, is shared with ARS' Houma

SCOTT BAUER

location, which collaborates closely with the Louisiana Agricultural Experiment Station at Baton Rouge and the American Sugar Cane League of the U.S.A.

"That partnership has resulted in the releases of 43 sugarcane varieties since 1924," says Benjamin L. Legendre, an ARS research agronomist who heads the Houma station.

Today, Louisiana's top variety is CP (Canal Point) 70-321, planted on about 43 percent of the state's 380,000 acres. The second and third leading varieties are CP 65-357, and CP 72-37O. Released to sugarcane growers over 10 years ago, these ARS varieties continue to produce excellent yields.

Legendre says all the varieties are adapted to Louisiana's subtropical climate, short growing season, varying soil types, and mechanical harvesting. The varieties also resist sugarcane mosaic, smut, and other diseases and can withstand infestations by sugarcane borers, which otherwise tunnel through cane stalks, reducing sucrose quality and yield

Key to the success of many Louisiana sugarcane varieties is their ability to mature in a short growing season and withstand sudden frosts that signal winter's approach. But in Hawaii, 4,300 miles and a world away, harsh winters are just a bad dream, unknown in the islands' tropical climate. Raising cane in this paradise means nurturing the crop through an economical, 2-year cycle that allows vigorous young plants longer time to make and store sugar.

Some varieties, though, have an unwelcome tendency to flower their first year, with the net effect of reducing sugar yields.

This was one of the earliest problems that researchers from ARS and the Hawaiian Sugar Planters' Association tackled during the past 41 years of collaboration in the association's laboratories on the island of Oahu. Their research showed that careful application of a chemical—ethephon—will stop early flowering.

Today, the team is helping streamline tomorrow's mapping of sugarcane genes. Paul H. Moore, who heads ARS' Sugarcane Physiology Research Unit on Oahu, directs a project that has yielded unique laboratory plantlets of a wild sugarcane relative.

Produced from specially nurtured male cells that scientists meticulously excised from cane's tiny flowers, these plantlets contain far fewer chromosomes than commercial cane. This simplifies the search by sugarcane scientists worldwide for genes that dictate sugar yields or enable plants to resist drought, disease, or insect attack.—By **Jan Suszkiw** and **Marcia Wood**, ARS.

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Benjamin L. Legendre is in the USDA-ARS Sugarcane Research Unit, P.O. Box 470, Houma, LA 70361; phone (504) 872-5042, fax (504) 868-8369.

Paul H. Moore is in the USDA-ARS Sugarcane Physiology Research Unit, P.O. Box 1057, Aiea, HI 96701; phone (808) 487-5561, fax (808) 487-5020. ◆

At the ARS Sugarcane Field Station, plant geneticists Jim Miller (left) and Peter Tai inspect a selection from stage II of the Canal Point sugarcane breeding program. (K5602-1)

BRUCE FRITZ

Science in Your Salad

The flowers of male-sterile plants needed for producing superior hybrid onions are being evaluated by geneticist Michael Havey. (K5608-1)

You may not think of this as you pour dressing on your salad, but ARS plant breeders put a lot of research into the vegetables before they reached your plate.

Thanks to their research, carrots, onions, cucumbers, and garlic taste better and contain more nutrients. And better crop yields and disease resistance make more of these favorite foods available.

To meet U.S. grower and consumer needs, the vegetable seed industry today uses breeding stocks developed by ARS researchers and cooperating state agricultural experiment stations.

Plant geneticist Philipp W. Simon, who is at the ARS Vegetable Crops Research Laboratory in Madison, Wisconsin, says that these stocks account for about 80 percent of the parentage of carrot seed, 55 percent of onions', and 30 percent of the parentage of cucumbers grown in the United States.

The first garlics from seed in the United States came from this research program. It is now possible to grow garlic like onions. This permits breeders to introduce genetic variability into the crop, which can't be done by growing garlic from bulbs.

ARS vegetable breeders have also produced carrots with improved yield, color, flavor, and disease resistance. Higher yielding onions have excellent storage quality and disease resistance, and new varieties of cucumbers now resist 10 diseases.

Overall, ARS researchers in Madison conduct about 60 percent of carrot research in the U.S. public

sector, 35 percent of cucumber research, 30 percent of onion research, and 90 percent of the garlic research.

Look What's Happening to Carrots

A great source of fiber and bulk, carrots also provide 30 percent of the vitamin A consumed in the United States. And carrots are highly valued today for their health benefits—especially, beta carotene content.

Thirty years ago, when an ARS plant breeder, the late Clinton E. Peterson, began improving carrots, they contained only about 70 parts per million (ppm) carotene. Today, most commercially grown carrots typically contain 120 to 160 ppm carotene, thanks to the work of Peterson and Simon.

By the year 2000, new germplasm currently being evaluated and bred by ARS and state plant researchers could triple the amount of carotene in carrots—an effort that could improve human nutrition in the United States and in underdeveloped countries where lack of vitamin A impairs the eyesight of many children.

"With genetic selection and traditional breeding, we could raise average carotene levels up to 270 parts per million. These varieties may cost only 3 to 5 cents for seed per year, yet provide 100 percent of the adult U.S. recommended dietary allowance of vitamin A for a year on a square meter of land," says Simon.

Getting people to eat more carrots may be a bit of a challenge, but one that ARS has already tackled. Scientists have produced varieties with potential for the processed carrot market. Basic Vegetable Products, a supplier of dehydrated ingredients for dried foods in Modesto, California, is considering several of them for new raw carrot snack products. These inbreds have high solids (dry matter) that may make them suitable for dehydration, says Simon.

Beta III is being evaluated by Basic Vegetable Products for use in encapsulated vitamin A supplements, according to Don Nelson. Nelson, who is the company's associate agricultural research manager, says this variety was released in 1986.

BRUCE FRITZ

Horticulturist Jack Staub measures the length and diameter of cucumbers from experimental hybrids. (K5609-1)

Orlando Gold, released by ARS in 1982, now appears in the peeled baby carrot market in California. For several years it has accounted for over two-thirds of Florida's carrot acreage. Seed of Savory and A Plus—both good eating carrots—is available to home gardeners. Both were released in the mid-1980's. All three varieties were developed cooperatively with university scientists.

Simon estimates that at least 80 percent of all carrots grown in the United States today contain at least one genetic component of USDA-ARS germplasm. With continued work on genetic plant selection and biotechnological methods, the carrots our grandchildren and great-grandchildren eat will be sweeter, contain even higher carotene levels, resist diseases and insects, and require fewer chemical inputs.

Super Onions, Pillow-Free Cukes

Super onions have come from the ARS breeding program that began in 1936 by ARS plant breeder Henry Jones in Beltsville, Maryland. Over 41 varieties and 63 inbred lines of hybrid onions have been released. Jones discovered the male-sterile system for producing hybrid onions that has been used by industry since the 1940's. He developed the first onion hybrid, California Hybrid #1.

In 1968, the onion breeding research program moved from Beltsville to Madison, Wisconsin. Again, Peterson's work altered onions throughout the world. He developed 21 inbreds and released them jointly with the agricultural experiment stations of Iowa, Michigan, New York, and Wisconsin. Among the hybrids from these inbreds are Spartan Banner 80, Sweet Sandwich, and Blitz.

Blitz is now grown on 2,000 acres in northern New York, Wisconsin, and Canada, according to plant breeder Scott Hendricks, who is with the Asgrow Seed Company in DeForest, Wisconsin. He says Blitz is the earliest maturing storage onion available in the United States or Canada. Spartan Banner 80, released in 1979, is No. 1 in the eastern United States. Acreage planted in Spartan Banner 80 now represents about 15 percent of the 2-million-ton storage onion market.

Sweet Sandwich, released by ARS and the agricultural experiment stations of Michigan and New York in 1982, is marketed by New York growers and Cornell University

BRUCE FRITZ

Geneticist Philipp Simon prepares carrot flowers for pollination. Bred for commercial production, the harvested carrots (with tops) contain genes from wild and unimproved relatives such as those displayed at bottom center. (K5607-1)

researchers as a sweet onion with long storability that may compete with Vidalia onions.

"ARS research has produced sweeter onions that are more disease resistant than their predecessors," says Michael J. Havey, the ARS plant geneticist who is now leading the onion research program in Madison. Havey says that with continued genetic improvements, we can extend the shelf life of onions for overseas markets and open up more export opportunities for U.S. onion growers.

Havey has developed a quick genetic test to identify plants that can be used to develop maternal and paternal inbreds of onion hybrids. Using DNA genetic markers, he has lowered the cost and cut the time of developing potential sources of new lines from several years to about a week or so.

"Because this information can be obtained in just a few days," says Havey, "onion breeders can now focus on developing hybrids with disease resistance and flavor characteristics that are most desired by industry."

Cucumbers have also profited from genetic selection for disease resistance and improvements in production methods. Peterson and ARS plant breeder Jack E. Staub combined resistance to 10 diseases in one inbred. With its multiple resistance to disease, inbred WI 2757 has been used widely by industry for hybrid development since 1982.

In 1987, the Claussen Pickle Company in Woodstock, Illinois, approached Staub with a heat- and calcium-related problem occurring during the growing season.

Extremely high temperatures cause cucumbers to become "pillowy," forming white Styrofoam-like areas that show up as discolorations in finished pickles. This condition has been costing industry an annual $2.5 million, according to Staub. He reduced the problem by identifying hydrocooling temperatures that have markedly decreased losses. Now, he is breeding plants that are less likely to become pillowy.

Within the next year, ARS and the University of Wisconsin will be releasing a cucumber of a different color. The as yet unnamed cucumber has orange flesh and packs a carotene wallop. "It's a good pickling cucumber too," says Simon.

Well-known for its medicinal and health attributes, garlic is reputed to fight off infections, thin the blood, and reduce blood cholesterol. But reproducing it from seed has been impossible. Now, for the first time in garlic's several-thousand-year history, Simon has developed a system to reproduce it from true seed. Details of the system are being published this fall in the journal *Sexual Plant Reproduction.*

"We are now working on combining traits of different garlic plants that may produce sweeter and less pungent flavors, improved disease resistance and yields, and a shorter growing season," says Simon.—**By Linda Cooke,** ARS.

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Science Update

Infrared Bug-Counter Goes to Disney World

One of the latest "rides" at Florida's Disney World is a new, ARS-designed system that automatically counts natural enemies of insect pests. Before, scientists with The Land facility at Disney's Epcot Center estimated or tediously hand-counted over 10,000 tiny parasitic *Opius dissitus* wasps reared and released weekly as alternatives to pesticides against leafminers. In ARS' system, an infrared beam counts as each lab-reared leafminer larva—infested with an egg laid by a female wasp—drops from a leaf, passes through the beam, slides down a funnel, and plops into one of a series of cups on a turntable. Keeping tally, a computer rotates the turntable when a cup gets the allotted number of wasp-infected larvae. Larvae are placed in greenhouses and outdoors to serve as wasp food until the parasites reach adulthood 2 weeks later. Then, *Opius* adults hunt for and lay eggs in leafminers threatening The Land's greenhouse crops and outdoor ornamentals. Biocontrol companies may commercially develop the system once ARS files a patent application. *Dennis Shuman, USDA-ARS Insect Attractants Laboratory, Gainesville, Florida; phone (904) 374-5737.*

New Apples, Nectarine for the Southeast

Three new ARS fruit varieties could show up next year at pick-your-own operations, roadside stands, and markets in the Southeast. Early Thompson apples, adapted in the Appalachians from Virginia to Georgia, ripen in early summer. They have purple-red skin and juicy, fine-textured white flesh with a pleasant balance of sweetness and acidity. For late fall and early winter harvest, the Hardy Cumberland apple is rated excellent in eating quality. The trees withstand the fluctuating spring temperatures of the southern Appalachian highlands. ARS released both varieties in cooperation with the University of Tennessee. The new nectarine, Sunsplash, ripens in early to mid-May—one of the earliest in south Georgia. Adapted to coastal plains of Florida, Georgia, and South Carolina, Sunsplash was developed in cooperation with the University of Georgia and University of Florida. *Ann Amis, USDA-ARS Southeastern Fruit and Tree Nut Research Laboratory, Byron, Georgia; phone (912) 956-5656.*

Company To Market New ARS Bacterium for Soybeans

Urbana Laboratories of St. Joseph, Missouri, licensed an ARS-developed strain of *Bradyrhizobia* bacteria that could boost soybean yields. Farmers will be able to buy the new strain as a seed inoculant for next spring's planting. Soybeans and other legumes use *Bradyrhizobia* to draw nitrogen from the atmosphere and fix it as a nutrient in root nodules. Many farmers buy inoculants to edge out less efficient bacteria already in the soil. In tests, the new *Bradyrhizobia* produced soybean yields 5 to 7 percent higher than did the top-performing commercial inoculant. *David Kuykendall, USDA-ARS Soybean and Alfalfa Research Laboratory, Beltsville, Maryland; phone (301) 504-5736. William J. Hunter, USDA-ARS Crops Research Laboratory, Fort Collins, Colorado; phone (303) 498-4208.*

JERRY PAYNE

Early Thompson apples, adapted for the Appalachians from Virginia to Georgia, ripen in July. They are named in honor of retired geneticist James M. Thompson (shown). (NY5-94—6)

Promising Biotech Vaccine To Be Tested

New gene-engineered vaccines for Japanese encephalitis will be field-tested in swine, now that they have protected mice and pigs from the disease in lab tests. To the genes of two harmless poxviruses, *vaccinia* virus and canarypox, scientists added genes for proteins on the coat of Japanese encephalitis virus. Vaccines are essential to protect U.S. swine from a serious threat if the disease—prevalent in large parts of Asia—enters this country. Existing commercial vaccines can stunt the growth of pigs. ARS developed and tested the new vaccines in collaboration with Yale University School of Medicine and Virogenetics, Inc., Troy, New York. *Peter W. Mason, USDA-ARS Plum Island Animal Disease Center, Orient Point, New York; phone (516) 323-2500.*

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Upcoming in the NOVEMBER Issue

- How do we preserve the ecological health of America's rangelands? ARS scientists at 25 locations look for innovative answers.
- A newly discovered component of yellow corn turns out to be a key to the flavor and aroma of tortilla flour.
- Instead of a high-tech chrome-and-glass laboratory, the primary testing facilities for a cutting-edge, salmonella-stopping technology are six low-slung gray metal farm buildings in Puerto Rico.